Original Article

EVALUATION OF SURGICAL TIMING IN PATIENTS WITH SPINE METASTASES AND ACUTE SEVERE NEUROLOGICAL DEFICIT

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ABSTRACT

Spine metastases are one of the main causes of non-traumatic spinal cord injury (SCI). The acute onset of a neurological deficit in cancer patients with metastases makes it necessary to perform a rapid decompression of the vertebral canal, generally within 48 hours of the onset, to improve the clinical and neurological outcome, avoiding the onset of edema, venous congestion and secondary vascular damage. However, the optimal timing for performing this procedure is a matter of debate in the literature. The aim of our study is to evaluate whether an early surgical intervention in patients with vertebral metastases debut with acute neurological deficit influences the clinical outcome. The study includes a series of 40 patients with vertebral metastases and acute onset of neurological deficit, who underwent decompressive laminectomy and vertebral arthrodesis from September 2013 to March 2021. For each patient has been collected information relating to age, sex, of admission to the emergency room and time of surgery, level of the lesion, pre- and post-operative neurological function evaluated with the Frankel scale and histology of the neoplastic lesion. In the population studied, the pre-operative Frankel value was distributed as follows: 17 grade A patients, 19 grade B patients and 4 grade C patients. As regards the surgical timing from the onset of the deficit, 15 patients were operated on in the first 12 hours, 9 patients between 12 and 24 hours, 2 patients between 24 and 48 hours, while 14 patients were operated after 48 hours. A statistically significant difference was found ($p < 0.05$) in terms of neurological outcome between those who were operated within 12 hours from symptom onset and patients operated subsequently. All subjects operated within 12 hours had a clinical improvement. On the basis of the collected and analyzed data, it is advantageous a surgically strategy within 12 hours from the onset of neurological symptoms in patients with vertebral metastases. In agreement with the literature, also in the series of this study, the early approach proved to be favorable. Therefore, it is reasonable to assume that an early management of the lesion allows to interrupt the cascade of events responsible for the secondary damage, with a consequent better residual medullary function.

KEYWORDS: *spinal tumors, surgical intervention, timing*

INTRODUCTION

Spinal Cord Injury (SCI) is a lesion of the spinal cord, partially or completely, that compromises its function, for a limited period of time or permanently. SCI can be due to various causes, which can be roughly divided into traumatic and

Received: 22 February 2023
Accepted: 28 March 2023

non-traumatic. Among the non-traumatic causes, the most important are the neoplastic one (linked to primitive neoplasms of the spinal cord or metastases) and mechanical/degenerative ones. Other causes are vascular, infectious, inflammatory and deficient (for example vitamin B12 deficiency) (1, 2).

The main therapeutic and neuroprotective treatment, therefore, should be implemented in the initial phase, to prevent the onset of secondary damage (3).

There are various mechanisms responsible for the secondary damage, in particular, among all of them, the alterations of the vascular microcirculation, which consist in the appearance of intravascular thrombi, hemorrhagic petechiae and vasospasm.

One of the major causes, in epidemiological terms, of non-traumatic SCI is neoplastic metastasis. Bones are among the main sites of metastatic localization of neoplasms; more than 90% of metastases are extradural and involve the bone component (4). The portions of the spine most frequently affected, based on frequency, are the thoracic tract, the lumbar tract and finally the cervical tract (5). The most common symptom is rachis pain, which typically gets worse in the supine position and improves in orthostatisn. After back pain, in order of frequency, there are motor disturbances, such as weakness, gait disturbances and paraplegia, but also sensory deficits, such as paraesthesia and anesthesia, and neurovegetative disturbances (6).

The specific treatment of myelolesion includes surgery, a medical treatment based on steroids, the management of complications (for example, heparin prophylaxis is used to prevent episodes of deep vein thrombosis) and any pharmacological devices for neuroprotection.

The therapeutic management of these pathologies is based on radiotherapy, often used as adjuvant therapy, or in case of absolute contraindication to surgical treatment. Conventional radiotherapy involves the irradiation of the affected vertebrae, including in the field also one or two vertebrae above and below the pathological one. Surgery is also a tool of decompression.

For thoracic and lumbar lesions, the standard surgical approach involves decompression and stabilization of the spine with screws and bars via a posterior approach. For cervical lesions, on the other hand, decompression and corpectomy is performed via a ventral approach, with placement of a prosthesis (7).

Surgery remains the fulcrum of therapy, especially in cases with spine instability and spinal cord involvement, which aims at pain management, improvement of neurological symptoms, stabilization of the spine and therefore improvement of quality of life. The treatment of vertebral metastases requires a multidisciplinary approach, personalized for each patient (8).

In literature, the debate regarding the optimal timing for surgery is still open. In general, the Authors suggest intervening as early as possible, generally there is approval in the 48-hour cut-off, to improve the clinical and neurological outcome, avoiding the onset of edema, venous congestion and secondary vascular damage (9).

Considering the high discordance of the studies in the literature, it is difficult to establish the optimal surgical timing in patients with vertebral metastases starting with neurological deficit. The aim of our study is to evaluate the timing in wich an early surgical intervention in patients with vertebral metastases starting with acute neurological deficit influences the clinical outcome prognostically.

MATERIALS AND METHODS

Patient population

The study includes data of 40 oncological patients, operated on between September 2013 and March 2021 at the Department of Neurosurgery of the Ospedale Riuniti Ancona. All the patients accessed the emergency room with an acute onset stenic deficit. Retrospectively, clinical information was gathered for each patient, in particular relating to age, gender, time of admission to the emergency room and time of surgery, level of lesion (cervical, thoracic, lumbar or sacral spine), pre- and post-operative neurological functions, surgical technique used, any post-operative complications and histological examination of the primary neoplasm. Furthermore, in the context of pre-operative planning, each patient was evaluated through MRI imaging study.

Frankel scale

The Frankel scale was used to evaluate the neurological symptoms and, in this study, was used to compare neurological functions before and after the surgery. All the patients in the study, in fact, presented a certain degree of neurological deficit, which was measured and monitored through this clinical score.

Data analysis

A statistical analysis of the data was performed, in order to demonstrate any significant difference in the neurological outcome of the patients operated on with different timing. For this purpose, the analysis of variance system ANOVA was used, in order to compare differences between certain groups. A result with p-value < 0.05 was considered significant.

RESULTS

Study population

The sample population consists of 26 men and 14 women, with an average age of 66 ± 14 years. Table I below summarizes the histology of the primary lesions of all the patients. In agreement with literature data, the tumors most frequently found in our series are lung, prostate, breast, hematological neoplasms and those of the gastro-intestinal tract.

Table I. *Histology of study's tumors*.

Primary lesion	**Num. of patients**
Lung	11
Prostate	6
Breast	3
Multiple Myeloma	3
Colorectal	3
DLBCL	2
Stomach	2
Pancreas	2
Follicular B Lymphoma	1
Thyroid	1
Klatskin's tumor	1
NET	1
Sarcoma	1
Ewing's sarcoma	1
Seminoma	1

In the population studied, the pre-operative Frankel value was distributed as follows: 17 patiens grade A, 19 patients grade B and 4 patients grade C. In the post-operative period, however, the values tend to improve. Indeed, 5 patients remained classifiable as A, 8 patients as B, 15 patients as C, 11 patients as D and one patient as E.

In our study, the most frequently affected tract was found to be the thoracic one, with 35 patients; the lumbar spine was involved in 3 patients, while only 2 patients had a cervical localization.

The surgical techniques used are: arthrodesis with vertebral decompression via laminectomy, laminectomy alone or vertebral stabilization alone.

During the postoperative period, most patients had no post-operative complication, while one patient developed a paravertebral hematoma and one patient developed a CSF fistula.

Finally, with regard to surgical timing, the patients in the study were divided according to the time between the onset of symptoms and surgery. As shown in the Table II below, 15 patients were operated on in the first 12 hours, 9 patients between 12 and 24 hours, 2 patients between 24 and 48 hours, while 14 patients were operated on after 48 hours.

Table II. *Surgery timing*.

Surgery timing	Num. Of patients
Within 12 h	15
12 - 24 h	9
24 - 48 h	2
After 48 h	14

Through statistical analysis, a statistically significant difference ($p < 0.05$) was found, in terms of neurological outcome, between those who were operated on within 12 hours of the onset of symptoms and patients operated on later. In fact, all subjects operated on within 12 hours had a clinical improvement, assessed by Frankel grade.

On the other hand, no statistically significant differences ($p > 0.05$) were found when evaluating the time cut-off of 24 hours and 48 hours.

Then, it was evalueted the link between the age of the patients and the change in the Frankel grade, to verify any improvement associated with particular age groups. However, these results did not prove to be statistically significant.

DISCUSSION

Given the high incidence and the important clinical, psychological, economic and social impact of spinal cord injuries, over the years we have tried to define the best way to manage patients with SCI, to restore their functionality and quality of life.

Specifically, patients with metastasis of vertebral column arising with neurological deficits, we tried to define the optimal surgical timing for maximun benefit, in terms of recovery the neurological functionality. Various authors propose different cut-offs, based on the data they have collected. In fact, in some studies are set relatively early deadlines, while in others is also accepted a more permissive time frame.

In general, there is a tendency to consider and recommend an approach as early as possible. In fact, knowing the pathophysiology of acute SCI, it is considered that early management of the lesion allows interrupting the cascade of events responsible for the secondary injury, with a consequent better residual spinal cord function.

As in other works, in this study the improvement of neurological function (assessed by Frankel grade) in relation to the time elapsed between the onset of weakness and surgery was retrospectively evaluated. In our series, the difference between patients operated on within 12 hours of the onset of symptoms and patients operated on later was statistically significant. On the other hand, the cut-offs of 24 and 48 hours were also evaluated, but were not found statistically significant differences. These results are in agreement with the general tendency of the literature to suggest an early and timely approach.

The main limitations of this study were the number of patients and the high heterogeneity of the patients examined. Furthermore, the significant variability of the subjects under examination could have influenced the statistical evaluation.

In fact, the patients studied have variable demographic characteristics, are affected by different neoplasms, with various metastatic localizations and have undergone different surgical interventions.

All these variables can influence the final outcome, therefore further studies are useful, which allow the evaluation of larger and more homogeneous population samples for demographic and clinical characteristics.

CONCLUSIONS

Based on the analyzed data, it is advantageous to intervene surgically within 12 hours of the onset of neurological symptoms in patients with vertebral metastases. In agreement with the literature, in fact, also in the series of this study, the early approach proved to be favorable, allowing to improve the neurological prognosis. The timing that is more advantageous is placed on the 12-hour cut-off.

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